

**ABUNDANCE, AGE, SEX, AND SIZE STATISTICS  
FOR PACIFIC HERRING IN LOWER COOK INLET, 1994**



by

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## ABSTRACT

The preseason forecast of 22,991.8 tonnes (25,344 tons) was used as the best estimate of the 1994 run biomass of Pacific herring *Clupea pallasii* in Kamishak Bay District, Lower Cook Inlet Management Area, Alaska. An inseason estimate of run biomass could not be made since there were 11 consecutive days in May when aerial surveys could not be flown because of poor weather or turbid water. The district was open to commercial purse seining on 25 and 29 April and a total of 1,965.5 tonnes (2,166.6 tons) of herring were harvested for sac roe. Herring were collected to obtain sex, age, weight, and length data from fishery landings as well as during test fishing operations conducted between 22 April and 1 May. Age-6 herring from the 1988 year class were the largest component of the run and comprised 51.5%, of the commercial harvest. The next two most abundant cohorts were age-10 herring from the 1984 year class, which comprised 10.9% of the harvest, and age-7 herring from the 1987 year class, which comprised 10.6% of the harvest. Although few age-3 and -4 herring were present in samples, we were unable to determine whether this was due to weak year classes or the unavailability of samples from later in the season. Males represented 55.7% of all catch samples. Mean weight and length of both sexes combined were 220 g and 253 mm. The 1994 run biomass in the Southern District was estimated to be 894.4 tonnes (983.9 tons). This district was not opened to commercial fishing, and age composition samples were not collected.

KEY WORDS: Abundance, age, *Clupea pallasii*, harvest, length, Lower Cook Inlet, Pacific herring, run biomass, sex, weight



## INTRODUCTION

This report presents abundance, age, sex and size data from herring samples collected during the 1994 spawning migration into the Kamishak Bay and Southern Districts of the Lower Cook Inlet management area, Alaska (Figure 1). Herring that spawn in Kamishak Bay migrate into Shelikof Strait, part of the adjacent Kodiak Management Area, during the winter (Johnson et al 1988). A management plan for Kamishak Bay herring stocks was adopted by the Alaska Board of Fisheries in 1992 limiting the spring sac roe fishery in Kamishak Bay to 18% and the fall food/bait fishery in Shelikof Strait to 2% of the preseason forecast of spawning biomass. The commercial purse seine fishery in Kamishak Bay for herring sac roe began in 1973. Entry into this fishery was limited in 1978, when 75 permits were issued (Schroeder 1989). This fishery was closed between 1980 and 1985 because of low herring population abundance. The Shelikof Strait food/bait herring fishery began in the early 1920's as a late summer and fall reduction fishery for fish meal as well as some salted food and bait products (Johnson et al. 1988). Presently, the Shelikof Strait fishery is primarily a fall and winter fishery producing frozen bait for local longline and crab vessels. Commercial fishing for herring in the Southern District began in 1914. Gillnets were used until purse seines were introduced in 1923. This fishery supported eight salteries during its peak, between 1924 and 1926, before the herring population collapsed. The population appeared to recover by the late 1960's and the Southern District was reopened in 1969 for a commercial sac roe herring fishery. Unfortunately, the herring population declined to very low abundance levels again in 1980 and, since that time, the Southern District has been reopened for a sac roe fishery only during 1989.

The Alaska Department of Fish and Game (ADF&G) began documenting Lower Cook Inlet herring catches in 1961. Catch sampling for age, weight, length, and sex, (AWL) data did not begin until 1971. Inseason assessment of the spawning population began in 1978 with a program of aerial surveys to estimate biomass and test fishing to estimate age, sex and size composition (Appendices A-G). Annual summaries of catch and run biomass estimates are published in Lower Cook Inlet Annual Management Reports (e.g., Bucher and Hammarstrom 1994). The 1971-1987 AWL data was summarized by Schroeder (1989). Sampling data after 1987 have been annually reported by Yuen et al. (1989, 1990, 1991), Yuen, Bucher and Bechtol (1994), and Yuen and Bucher (*in press*). Aerial survey and AWL data have been incorporated into age-structured-analysis models to generate preseason forecasts of spawning biomass since 1994 (Yuen, Brannian, and Funk 1994).

## METHODS

### *Biomass Estimates*

Run or spawning biomass refers to the herring population estimated to be on the fishing grounds between mid-April and June. These herring are considered to be recruited into the spawning population and available for sac roe harvest. Catch limits are typically achieved by the fishing fleet by mid-May. Escapement biomass refers to the portion of the population that was estimated to have spawned. This estimate is obtained by subtracting the harvest from the run biomass. Harvest estimates are obtained directly from harvest receipts, often referred to as fish tickets, which document each sale made by a permitted fisher.

Aerial surveys are flown in a single engine fixed-wing aircraft at an altitude of about 457 m (1,500 ft). Although surveys may be flown at different tide stages, the best water clarity and visibility of herring schools usually occurs during the three or four hour period following low slack tide. During each flight, surveyors record surface area and location of each herring school, extent and location of milt, and survey conditions on standard index maps. Herring school surface areas are transformed into biomass estimates using the following conversion factors: 1.38 tonnes/7 m<sup>2</sup> (1.52 tons/538 ft<sup>2</sup>) for water depths < 4.9 m (16 ft); 2.33 tonnes/7 m<sup>2</sup> (2.56 tons/538 ft<sup>2</sup>) for depths between 4.9 m and 7.9 m (16 and 26 ft); and 2.57 tonnes/7 m<sup>2</sup> (2.83 tons/538 ft<sup>2</sup>) for depths > 7.9 m (26 ft). These conversion factors have been obtained by capturing individual schools with purse seines after surface area estimates have been obtained by an aerial surveyor. New information on conversion factors was not obtained during 1994.

Daily biomass estimates are usually combined during the season to produce a run biomass estimate. If more than one survey is flown on the same day, only data from the survey having the greatest biomass estimate is included as part of the run biomass estimate. Daily biomass estimates are added together to calculate run biomass only if herring schools appeared to be spawning and leaving the survey area each day. If herring schools appeared to be remaining in the survey area for several days, only peak surveys separated by several days, are added together to calculate run biomass.

In 1994, inclement weather obscured visibility for surveyors in the Kamishak Bay District, making it difficult to obtain a good series of daily biomass estimates. Therefore, run biomass was estimated using two independent methods. The first used the preseason forecast, which is based on survival rates and abundances. The second used a two-step expansion of aerial survey data based on the proportion,  $p_d$ , of the run biomass expected on date  $d$  (Yuen *in press a*). For the second method, an initial estimate of run biomass,  $\hat{B}$ , is made as follows:

$$\hat{B} = \frac{\sum b_d}{\sum \bar{p}_d} , \quad (1)$$

where  $b_d$  = daily aerial survey estimate of biomass, and both  $b_d$  and  $p_d$  must be > zero. This initial estimate is then adjusted based on the linear relationship fitted to past data:

$$B = -5050.0252 + 1.5003\hat{B}. \quad (2)$$

### *Age, Weight, Length, and Sex Composition*

#### **Source of Samples**

Kamishak Bay aerial survey data were placed into two strata in 1994: one for samples obtained from commercial fishery harvests, used to represent herring in the harvest, and the other for samples obtained from test fishing before and after the fishery, used to represent the escapement. Commercial catch samples were obtained immediately after the fishery closed. Samples were dip-netted from the pursed seines of fishing vessels waiting for a tender to pump herring from their nets. No attempt was made to sample purse seines in a statistically random manner due since our sampling effort was limited. Test fishing was done from commercial purse seine vessels that were chartered by ADF&G to fish during specified times in specified areas.

All herring samples were packed in 15 kg (33-lb) boxes and flown to the Homer ADF&G office complex for processing. If the total number of herring obtained was greater than the number required for a sampling stratum, each 15 kg box was subsampled by dumping the same proportion from all of the 15-kg boxes into a common sink and processing every herring in the sink. This procedure was repeated until the required number of herring had been sampled. All samples were quickly processed upon their arrival in Homer to provide timely age composition information for use in management decisions.

#### **Sample Sizes**

The number of herring,  $n$ , for each sample was chosen such that all age  $i$  proportions,  $p$ , within a multinomial distribution of  $k$  age groups were simultaneously estimated within a specified distance,  $d$ , of their true population age proportions,  $\pi_i$ , with probability  $\alpha$  of making a type I error:

$$P\left\{\prod_{i=1}^k |p_i - \pi_i| \leq d\right\} \geq 1 - \alpha, \quad (3)$$

where  $d$  and  $\alpha$  were both chosen to be 0.05, and  $P$  was the probability of the hypothesis. Thompson (1987) calculated a maximum sample size of 510 for a worst-case scenario when three age classes were present in equal proportions and  $d = \alpha = 0.05$ . Smaller sample sizes would be required to achieve the same level of precision in cases where  $k \neq 3$  or age class proportions were unequal. We attempted to collect a total of 663 herring for each sample: 510 herring in case the worst-case scenario occurred plus a 30% allowance for herring which could not be aged. However, biological data was not obtained from all 663 herring in a sample. Instead, a minimum number of herring was chosen from each sample, equal to the value of  $n$  that satisfied the following:

$$\sum_{i=3}^{16} 2 \left[ 1 - \Phi \left( \frac{d\sqrt{n}}{\sqrt{(p_i(1-p_i))}} \right) \right] < 0.05, \quad (4)$$

where each  $p_i$  was the *a priori* age proportion for age- $i$  herring, based on the age composition of about 300 herring from the sample, and  $\Phi$  was the area under the standard normal distribution curve. After  $n$  herring, based on results of equation 4, had been aged, equation 2 was recalculated, using the  $p_i$  values obtained, to determine whether additional herring from the sample needed to be processed to meet chosen levels of  $d$  and  $\alpha$ .

Individual samples from the same or adjacent days for which age compositions which were not significantly different ( $P > 0.05$ ), based on results of Chi-square tests of independence (Snedecor and Cochran 1967), were combined.

### Sex, Length, and Age Determination

Sex of each herring sampled was determined by either extruding eggs or sperm from ripe individuals or inspection of gonads of green or spent individuals. Herring were measured to the nearest mm from the tip of the snout to the end of the hypural plate and weighed to the nearest g. Standard errors for lengths and weights of each age class were estimated using procedures for stratified random sampling described by Snedecor and Cochran (1967):

$$SE = \sqrt{\sum \left( \frac{C_h}{C} \right)^2 \left( \frac{s_h^2}{n_h} \right)}, \quad (5)$$

where  $C$  = herring catch,  $h$  = stratum or sample,  $s_h^2$  = sample variance, and  $n_h$  = sample size.

One scale was removed from each herring for ageing. We tried to take scales from the left side of each herring in the area above the pectoral fin and three or four scales posterior of the operculum. If no scales, or only regenerated scales, were present in this area, a scale was taken from the same area on the right side of the herring. If no scales, or only regenerated scales, were present in this area, the herring was not included in the sample. Each scale removed was cleaned, dipped in a 10% mucilage solution and positioned sculptured side up on a labeled glass slide. Each glass slide held a maximum of 20 scales. Scales on slides were viewed at a 29X magnification using a microfiche reader. The number of annuli per scale were counted to determine age.

## RESULTS

### *Kamishak Bay District*

A total of 14 aerial surveys were flown between 21 April and 5 June 1994 in the Kamishak Bay District (Table 1, Figure 2). As in other years, herring appeared earlier in southern (Fortification Bluff, Bruin Bay, Amakdedori, Chenik, Nordyke, and Kamishak Bay) than in the north (Oil and Iniskin Bays) areas within the District. Herring appeared to be moving through, rather than remaining within, the District during the sampled period, 22 April through 1 May, since age composition did not remain constant and no spawned females were obtained until 30 April. However, the sum of daily aerial survey biomass estimates was not used as the run biomass estimate because there were 11 days between 15 and 26 May when aerial surveys could not be flown because of poor weather or turbid water.

Aerial surveyors saw only 4,236.6 tonnes (4,660.3 tons) of herring (Table 1), considerably less than the preseason forecast of 22,991.8 tonnes (25,344 tons; Yuen et al 1994). Expansion of available aerial survey data produced a run biomass of only 6,021 tonnes (6,623 tons). Assuming the 1994 herring spawning migration was delayed by three days because of cool water temperatures (Figure 3 and Appendix H), the run biomass based on equations 1 and 2 was still estimated to have been only 7,254 tonnes (7,980 tons). After the commercial fishery was closed, aerial estimates of the shoreline extent of milt (11.59 km; 7.24 mi) were greater than any previous annual sighting. This led us to believe that inseason run biomass estimates were too small. Therefore, we assumed the preseason forecast of 22,991.8 tonnes (25,344 tons) was a better estimate of actual run biomass.

The 1994 preseason harvest projection, based on the preseason forecast, was 3,110.9 tonnes (3,422.0 tons; Yuen et al 1994). The District was opened to commercial fishing on only two days during the 1994 season, and resulted in a harvest biomass of 1,965.6 tonnes (2,166.6 tons). During the first opening, on 25 April, 35 permit holders landed 706.3 tonnes (778.5 tons).

During the second opening, on 29 April, 53 permit holders landed 1259.3 tonnes (1388.1 tons). The total number of herring estimated to have been harvested in 1994 (8,913,000) was much less than the total harvested in 1993 (17,477,000) and 1992 (13,600,000), but similar to the total harvested in 1991 (9,154,000; Appendix A).

A total of 1,777 readable scales were collected (Table 2) from test fishing samples before and after the commercial fishery, while 882 readable scales were obtained from commercial catch samples obtained on 25 and 29 April. Herring samples were combined by date since no significant differences ( $P>0.05$ ) were detected among samples taken on the same date. However, significant differences ( $P<0.05$ ) in age composition estimates were found among samples taken on different dates (Table 3-11). Herring sampled from the combined 25 and 29 April catch (Tables 7, 9) were used to estimate age, sex and size composition of the harvest biomass (Table 12), while herring sampled before and after the fishery (Tables 4-6, 8, 10-11) were used to estimate the age, sex and size composition of the escapement biomass (21,026.4 tonnes, or 23,177.4 tons; Table 13).

As was expected prior to the season, age-6 herring from the 1988 year class comprised most, 51.5%, of the 1994 catch (Table 12). However, age-10 herring from the 1984 year class, which comprised 10.9% of the catch, and age-7 herring from the 1987 year class, which comprised 10.6%, were both more abundant than was expected. Similar trends occurred in escapement samples: age-6 herring contributed 45.3%, age-10 12.9%, and age-7 11.2% of the portion of the escapement sampled (Table 13). Combining information from catch and escapement samples resulted in a run dominated by age-6 herring (45.8%), but having few age-3 herring (0.1%; Table 14). The low abundance of age-3 herring was not expected, since this age class comprised 11.3% of the preseason forecast (Appendix I).

Males represented 55.7% of the catch and 49.7% of the escapement samples (Tables 12 and 13). Mean weight and length of both sexes combined were 220 g and 253 mm in catch samples, and 210 g and 262 mm in escapement samples.

### *Southern District*

Aerial surveys were flown on seven dates between 3 May and 6 June in the Southern District (Table 15; Figure 4). The 1994 run biomass, estimated as the sum of all daily biomass estimates, was 894.4 tonnes (983.9 tons). No areas of milt were sighted during any surveys and no herring samples were obtained. Commercial fishing was not allowed in this district in 1994.

## DISCUSSION

Historically, seasonal changes in age composition of herring samples collected within Kamishak Bay District can be placed into three groups (Yuen *in press b*): 1) increased contribution of age-4 herring in late April or early May (1988, 1990, 1992); 2) increased contribution of age-3 and older herring in mid-May (1977 and 1986); 3) no change in contribution of age-3 or age-4 herring over time (1989), or only a very gradual increase in abundance of age-4 herring (1985). Herring samples collected during 1994 had few age-3 and -4 herring, which would place it into the third group. The small contribution of age-4 to the 1994 run would also support Yuen and Bucher's (*in press*) decision to place the 1993 run into the third group. However, the lack of age-3 and -4 herring in 1994 herring samples could be due to the absence of samples collected after 1 May rather than an actual lack of age-3 and -4 herring in the spawning population. If a large proportion of age-4 or -5 herring occur in 1995 samples, the 1994 age composition estimate documented in this report should be modified.

## LITERATURE CITED

- Bucher, W.A., and R. Hammarstrom. 1994. 1993 Lower Cook Inlet area annual finfish management report. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A94-11, Anchorage.
- Johnson, B.A., C. Burkey, and D. Gaudet. 1988. Stock identification of Pacific herring in Shelikof Strait, Alaska, 1985/86. Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak.
- Schroeder, T.R. 1989. A summary of historical data for the Lower Cook Inlet, Alaska, Pacific herring sac roe fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Fisheries Research Bulletin 89-04, Juneau.
- Snedecor, G.W., and W.G. Cochran. 1967. Statistical methods, 6th edition. John Wiley and Sons, New York, New York.
- Thompson, S.K. 1987. Sample sizes for estimating multinomial proportions. The American Statistician 41:42-46.
- Yuen, H.J. *In press a*. Herring run biomass estimates from expansion of aerial surveys and run timing in Lower Cook Inlet. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Alaska Fisheries Research Bulletin, Juneau.
- Yuen, H.J. *In press b*. A model to predict Pacific Herring age composition in early and late spawning migrations in Kamishak Bay, Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Alaska Fisheries Research Bulletin, Juneau.
- Yuen, H.J., L.K. Brannian, and F. Funk. 1994. Forecast of the Kamishak herring stock in 1994. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A94-12, Anchorage.
- Yuen, H.J., W.A. Bucher, and W.R. Bechtol. 1991. Abundance, age, sex, and size statistics for Pacific herring in Lower Cook Inlet, 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report 91-10, Juneau.



## LITERATURE CITED (Continued)

- Yuen, H.J., W.A. Bucher, and W.R. Bechtol. 1994. Abundance, age, sex, and size statistics for Pacific herring in Lower Cook Inlet, 1991. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Technical Fishery Report 94-12, Juneau.
- Yuen, H.J. and W.A. Bucher. 1994. Abundance, age, sex, and size statistics for Pacific herring in Lower Cook Inlet, 1992. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Technical Fishery Report 94-13, Juneau.
- Yuen, H.J. and W.A. Bucher. *in press*. Abundance, age, sex, and size statistics for Pacific herring in Lower Cook Inlet, 1993. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Technical Fishery Report, Juneau.
- Yuen, H.J., T.R. Schroeder, and R. Morrison. 1989. Abundance, age, sex, and size composition for Pacific herring in Lower Cook Inlet, 1988. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report 89-10, Juneau.
- Yuen, H.J., T.R. Schroeder, and R. Morrison. 1990. Abundance, age, sex, and size statistics for Pacific herring in Lower Cook Inlet, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report 90-10, Juneau.

Table 1. Herring biomass estimates by area and date, Kamishak Bay District, Lower Cook Inlet, 1994. DNS indicated that an area within the District was not surveyed during a flight.

Date	Survey Conditions	Spawn Sightings		Chinitna Dry Bays	Oil Bay	Iniskin Bay	Cottonwood Iliamna Bays	Ursus Cove	Fortification Bluff	Bruin Bay Amakdedori	Chenik Nordyke Island	Kamishak Bay	Douglas Reef	Augustine Island	Daily Total
		Number	Length (km)												
Biomass Estimates in Tonnes															
21 April	4	0	0.00	DNS	DNS	DNS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	0.0
22 May	4	0	0.00	DNS	DNS	0.0	0.0	0.0	2.4	2.4	0.0	0.0	0.0	DNS	4.7
24 May	3	0	0.00	DNS	DNS	DNS	DNS	DNS	0.0	0.0	44.0	1.4	DNS	DNS	45.4
25 May	2	0	0.00	DNS	DNS	DNS	DNS	DNS	2.4	37.2	85.7	147.0	0.0	DNS	272.2
25 May	2	0	0.00	DNS	DNS	DNS	DNS	DNS	DNS	1.4	76.1	93.4	4.2	DNS	175.1
29 May	2	2	0.48	DNS	DNS	11.1	0.0	0.0	14.1	0.0	607.5	130.8	1.4	0.0	764.9
30 May	3	5	3.89	DNS	DNS	24.9	0.0	0.0	0.0	0.0	217.3	8.3	0.0	DNS	250.4
1 May	3	3	1.28	DNS	DNS	81.4	0.0	0.0	25.7	24.9	6.9	DNS	DNS	DNS	138.8
6 May	4	2	1.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	0.0
13 May	3	3	1.60	0.0	0.0	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	12.4
15 May	2	1	1.28	0.0	0.0	295.2	99.1	218.4	461.0	206.7	418.9	597.1	89.7	0.0	2,386.1
26 May	3	6	1.94	0.0	18.4	128.2	0.0	0.0	0.0	0.0	192.2	0.0	0.0	DNS	346.1
31 May	4	0	0.00	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	4.2	0.0	DNS	6.9
5 June	4	0	0.00	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	0.0	0.0	DNS	0.0
Biomass Estimates in Tons															
21 April	4	0	0.00	DNS	DNS	DNS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	0.0
22 May	4	0	0.00	DNS	DNS	0.0	0.0	0.0	2.6	2.6	0.0	0.0	0.0	DNS	5.2
24 May	3	0	0.00	DNS	DNS	DNS	DNS	DNS	0.0	0.0	48.5	1.5	DNS	DNS	50.0
25 May	2	0	0.00	DNS	DNS	DNS	DNS	DNS	2.6	41.0	94.5	162.0	0.0	DNS	300.1
25 May	2	0	0.00	DNS	DNS	DNS	DNS	DNS	DNS	1.5	83.9	103.0	4.6	DNS	193.0
29 May	2	2	0.30	DNS	DNS	12.2	0.0	0.0	15.5	0.0	669.7	144.2	1.5	0.0	843.1
30 May	3	5	2.43	DNS	DNS	27.4	0.0	0.0	0.0	0.0	239.5	9.1	0.0	DNS	276.0
1 May	3	3	0.80	DNS	DNS	89.7	0.0	0.0	28.3	27.4	7.6	DNS	DNS	DNS	153.0
6 May	4	2	0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	0.0
13 May	3	3	1.00	0.0	0.0	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	13.7
15 May	2	1	0.80	0.0	0.0	325.4	109.2	240.7	508.2	227.9	461.7	658.2	98.9	DNS	2,630.2
26 May	3	6	1.21	0.0	28.3	141.3	0.0	0.0	0.0	0.0	211.9	0.0	0.0	DNS	381.5
31 May	4	0	0.00	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	4.6	0.0	DNS	7.6
5 June	4	0	0.00	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	0.0	0.0	DNS	0.0

Table 2. Number of readable herring scales collected during sampling, Kamishak Bay District, 1994.

Date	Location	Sample Size	P
<u>April</u>			
22	Chenik & Fortification Bluff	436	0.957
23	Chenik	293	0.903
24	Chenik	213	0.793
25	Nordyke	363	0.937
28	Iniskin & Nordyke	299	0.907
29	Chenik & Amakdedori	519	0.977
30	Chenik	309	0.923
<u>May</u>			
01	Iniskin	227	0.798

Table 3. Chi-Square test of independent herring age composition by area and date, Kamishak Bay District, 1994.

		Chenik 22 Apr	Chenik 23 Apr	Chenik 24 Apr	Catch 25 Apr	Iniskin&Nurdyke 28 Apr	Catch 29 Apr	Chenik 30 Apr	Iniskin 1 May
Chenik	22 Apr		20.73* 10	10.31 11	11.91 11	48.98* 12	25.12* 11	40.66* 11	84.57* 10
Chenik	23 Apr	20.73* 10		20.79* 11	20.23* 11	73.90* 12	20.90* 11	12.92 11	113.14* 10
Chenik	24 Apr	10.31 11	20.79* 11		4.29 11	22.55* 12	8.34 11	23.14* 11	52.27* 11
Catch	25 Apr	11.91 11	20.23* 11	4.29 11		36.98* 12	11.30 11	24.62* 12	75.37* 11
Iniskin&Nurdyke	28 Apr	48.98* 12	73.90* 12	22.55* 12	36.98* 12		48.22* 12	82.00* 12	18.58 12
Catch	29 Apr	25.12* 11	20.90* 11	8.34 11	11.30 11	48.22* 12		24.12* 12	100.42* 11
Chenik	30 Apr	40.66* 11	12.92 11	23.14* 11	24.62* 12	82.00* 12	24.12* 12		127.49* 11
Iniskin	1 May	84.57* 10	113.14* 10	52.27* 11	75.37* 11	18.58 12	100.42* 11	127.49* 11	

Table 4. Age, sex, and size composition of herring samples obtained prior to the fishery from Chenik Head and Fortification Bluff areas, Kamishak Bay District, 22 April 1994.

Sample Period	Age	Numbers of Fish						Percent of Total	Weight			Length		
		Immature Male	Ripe Female	Spawmed Female	Unknown	Total	Mean (g)		SD	Number Weighed	Mean (mm)	SD	Number Measured	
22 April	1													
	2													
	3													
	4	1	1	0	0	0	2	0.5	143	5.7	2	227	0.0	2
	5	9	2	2	0	0	13	3.0	176	18.2	13	240	6.9	13
	6	110	14	85	0	0	209	47.9	196	22.6	209	248	8.1	209
	7	19	7	24	0	0	50	11.5	214	29.2	50	254	9.8	50
	8	14	1	12	0	0	27	6.2	251	32.1	27	264	10.8	27
	9	20	0	11	0	0	31	7.1	272	24.7	31	271	8.0	31
	10	35	1	38	0	0	74	17.0	282	33.7	74	273	9.1	74
	11	8	1	15	0	0	24	5.5	287	44.7	24	274	13.2	24
	12	0	0	1	0	0	1	0.2	364	0.0	1	293	0.0	1
	13	2	0	2	0	0	4	0.9	286	23.8	4	276	4.2	4
	14	0	0	1	0	0	1	0.2	346	0.0	1	289	0.0	1
	15													
	16													
Combined Total		218	27	191	0	0	436	100.0	227	48.4	436	257	14.8	436
Sex Composition (%)		50.0	6.2	43.8	0.0									
Not Aged		19	3	22	0	0	44	10.1	245	62.1	44	261	18.5	44
Sex Composition (%)		43.2	6.8	50.0	0.0									

Table 5. Age, sex, and size composition of herring samples obtained prior to the fishery from Chenik Head, Kamishak Bay District, 23 April 1994.

Sample Period	Age	Numbers of Fish					Percent of Total	Weight			Length		
		Immature Male	Ripe Female	Spawmed Female	Unknown	Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
23 April	1												
	2												
	3												
	4	2	0	0	0	2	0.7	121	16.3	2	221	12.0	2
	5	3	1	3	0	7	2.4	158	12.9	7	238	7.3	7
	6	98	4	75	0	177	60.4	188	25.3	177	245	8.1	177
	7	22	1	17	0	40	13.7	217	27.1	40	255	9.9	40
	8	4	0	4	0	8	2.7	247	39.8	8	261	12.7	8
	9	6	0	7	0	13	4.4	267	27.7	13	270	9.6	13
	10	18	0	10	0	28	9.6	272	27.2	28	271	11.3	28
	11	7	0	5	0	12	4.1	281	32.0	12	272	9.5	12
	12	1	0	0	0	1	0.3	355	0.0	1	297	0.0	1
	13	3	0	1	0	4	1.4	269	63.2	4	269	20.5	4
	14	0	0	1	0	1	0.3	288	0.0	1	276	0.0	1
	15												
	16												
Sample Total		164	6	123	0	293	100.0	210	45.0	293	252	14.2	293
Sex Composition (%)		56.0	2.0	42.0	0.0								
Not Aged		15	2	10	0	27	9.2	213	49.1	27	251	15.9	27
Sex Composition (%)		55.6	7.4	37.0	0.0								

Table 6. Age, sex, and size composition of herring samples obtained prior to the fishery from Chenik Head, Kamishak Bay District, 24 April 1994.

Sample Period	Age	Numbers of Fish						Percent of Total	Weight		Number Weighed	Length		
		Immature	Ripe	Spawnd	Female	Unknown	Total		Mean (g)	SD		Mean (mm)	SD	Number Measured
24 April	1													
	2													
	3													
	4	3	1	1	0	0	5	2.3	133	15.6	5	222	6.1	5
	5	4	1	3	0	0	8	3.8	158	16.0	8	234	6.7	8
	6	54	5	42	0	0	101	47.4	191	24.6	101	245	7.7	101
	7	10	0	13	0	0	23	10.8	229	38.2	23	258	11.2	23
	8	10	1	5	0	0	16	7.5	249	29.6	16	266	10.1	16
	9	8	1	9	0	0	18	8.5	259	46.1	18	269	12.1	18
	10	11	1	15	0	0	27	12.7	280	35.5	27	272	10.1	27
	11	4	1	6	0	0	11	5.2	324	33.9	11	284	4.4	11
	12	1	0	0	0	0	1	0.5	297	0.0	1	290	0.0	1
	13	1	0	1	0	0	2	0.9	324	43.8	2	292	4.9	2
	14													
	15	1	0	0	0	0	1	0.5	354	0.0	1	285	0.0	1
	16													
Sample Total		107	11	95	0	0	213	100.0	223	55.1	213	255	17.1	213
Sex Composition (%)		50.2	5.2	44.6	0.0									
Not Aged		11	1	11	0	0	23	10.8	215	45.6	23	252	14.6	23
Sex Composition (%)		47.8	4.3	47.8	0.0									

Table 7. Age, sex, and size composition of commercial sac roe herring harvest by purse seine near Chenik Head and Amakdedori Creek, Kamishak Bay District, 25 April 1994.

Sample Period	Age	Numbers of Fish						Percent of Total	Weight		Length		Biomass		
		Immature	Ripe	Spawnd					Mean (g)	SD	Mean (mm)	SD	No. Fish X 1000	Tons	Tonnes
		Male	Female	Female	Female	Unknown	Total								
25 April	1														
	2														
	3														
	4	3	0	2	0	0	5	1.4	134	20.6	5	220	6.4	5	44
	5	7	0	7	0	0	14	3.9	177	28.2	14	242	11.1	14	123
	6	112	0	70	0	0	182	50.1	192	23.5	182	243	8.8	182	1602
	7	21	0	18	0	0	39	10.7	222	35.2	39	252	10.8	39	343
	8	14	0	9	0	0	23	6.3	251	38.8	23	258	12.0	23	202
	9	17	0	11	0	0	28	7.7	257	39.5	28	263	12.6	28	246
	10	20	0	24	0	0	44	12.1	276	35.4	44	267	9.6	44	387
	11	10	0	10	0	0	20	5.5	290	39.4	20	272	12.1	20	176
	12	2	0	3	0	0	5	1.4	319	10.3	5	281	7.0	5	44
	13	0	0	1	0	0	1	0.3	316	0.0	1	274	0.0	1	9
	14	1	0	0	0	0	1	0.3	303	0.0	1	281	0.0	1	9
	15														
	16	1	0	0	0	0	1	0.3	284	0.0	1	269	0.0	1	9
Sample Total		208	0	155	0	0	363	100.0	221	49.5	363	251	15.3	363	3195
Sex Composition (%)		57.3	0.0	42.7	0.0										
Not Aged		20	0	7	0	0	27	7.4	211	50.9	27	247	16.0	27	
Sex Composition (%)		74.1	0.0	25.9	0.0										



Table 8. Age, sex, and size composition of herring obtained prior to the fishery from Iniskin Bay and Nordyke Island, Kamishak Bay District, 28 April 1994.

Sample Period	Age	Numbers of Fish					Percent of Total	Weight			Length			
		Immature Male	Ripe Female	Spawmed Female	Unknown	Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	
<u>Iniskin</u>														
28 April	1													
	2													
	3													
	4	2	0	2	0	0	4	2.6	143	24.3	4	225	13.1	4
	5	6	0	3	0	0	9	5.9	165	19.6	9	239	6.7	9
	6	17	0	17	0	0	34	22.4	179	23.4	34	242	8.1	34
	7	9	0	5	0	0	14	9.2	216	31.0	14	255	8.4	14
	8	5	0	9	0	0	14	9.2	265	24.7	14	268	6.5	14
	9	13	0	2	0	0	15	9.9	266	33.9	15	269	6.7	15
	10	13	0	14	0	0	27	17.8	296	36.4	27	275	10.1	27
	11	11	0	11	0	0	22	14.5	299	27.0	22	275	6.8	22
	12	2	0	3	0	0	5	3.3	306	43.8	5	280	13.0	5
	13	2	0	2	0	0	4	2.6	301	12.6	4	281	0.8	4
	14	0	0	1	0	0	1	0.7	342	0.0	1	290	0.0	1
	15	2	0	0	0	0	2	1.3	359	57.3	2	294	9.9	2
	16	1	0	0	0	0	1	0.7	320	0.0	1	282	0.0	1
Sample Total		83	0	69	0	0	152	100.0	247	62.8	152	262	18.3	152
<u>Nordyke</u>														
28 April	1													
	2	0	0	0	0	3	3	2.0	18	2.3	3	131	9.5	3
	3	1	0	0	0	0	1	0.7	55	0.0	1	176	0.0	1
	4	4	2	2	0	0	8	5.4	144	34.5	8	229	14.6	8
	5	5	1	0	0	0	6	4.1	174	20.6	6	241	9.4	6
	6	30	0	26	2	0	58	39.5	188	26.6	58	247	9.1	58
	7	9	1	4	0	0	14	9.5	230	28.8	14	259	8.4	14
	8	7	0	3	0	0	10	6.8	270	36.9	10	271	7.3	10
	9	4	0	6	0	0	10	6.8	269	29.5	10	271	7.7	10
	10	12	0	9	0	0	21	14.3	293	37.1	21	277	5.8	21
	11	6	0	6	0	0	12	8.2	321	41.9	12	282	9.1	12
	12	1	0	0	0	0	1	0.7	252	0.0	1	273	0.0	1
	13	1	0	1	0	0	2	1.4	316	26.2	2	285	3.5	2
	14	1	0	0	0	0	1	0.7	333	0.0	1	285	0.0	1
	15													
	16													
Sample Total		81	4	57	2	3	147	100.0	225	69.7	147	255	26.2	147
<u>Iniskin &amp; Nordyke Combined</u>														
28 April	1													
	2	0	0	0	0	3	3	1.0	18	2.3	3	131	9.5	3
	3	1	0	0	0	0	1	0.3	55	0.0	1	176	0.0	1
	4	6	2	4	0	0	12	4.0	144	30.3	12	228	13.6	12
	5	11	1	3	0	0	15	5.0	169	19.9	15	240	7.7	15
	6	47	0	43	2	0	92	30.8	185	25.7	92	245	9.0	92
	7	18	1	9	0	0	28	9.4	223	30.2	28	257	8.6	28
	8	12	0	12	0	0	24	8.0	267	29.8	24	269	6.9	24
	9	17	0	8	0	0	25	8.4	267	31.6	25	270	7.1	25
	10	25	0	23	0	0	48	16.1	294	36.3	48	276	8.5	48
	11	17	0	17	0	0	34	11.4	306	34.1	34	277	8.2	34
	12	3	0	3	0	0	6	2.0	297	45.0	6	279	11.9	6
	13	3	0	3	0	0	6	2.0	306	17.0	6	282	2.5	6
	14	1	0	1	0	0	2	0.7	338	6.4	2	288	3.5	2
	15	2	0	0	0	0	2	0.7	359	57.3	2	294	9.9	2
	16	1	0	0	0	0	1	0.3	320	0.0	1	282	0.0	1
Combined Total		164	4	126	2	3	299	100.0	236	67.1	299	259	22.7	299
Sex Composition (%)		54.8	1.3	42.1	0.7									
Not Aged		13	0	8	0	0	21	7.0	223	56.5	21	256	17.7	21
Sex Composition (%)		61.9	0.0	38.1	0.0									

Table 9. Age, sex, and size composition of commercial sac roe herring harvest by purse seine in the Chenik Head and Amakdedori Creek areas, Kamishak Bay District, 29 April 1994.

Sample Period	Age	Numbers of Fish						Percent of Total	Weight			Length			Biomass		
		Immature	Ripe	Spawnd	Female	Unknown	Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	No. Fish X 1000	Tons	Tonnes
29 April	1																
	2																
	3																
	4	9	0	4	0	0	13	2.5	151	12.2	13	229	6.3	13	143	23.9	21.6
	5	9	1	10	0	0	20	3.9	172	21.0	20	239	6.3	20	220	41.9	38.0
	6	159	2	109	1	0	271	52.2	189	23.1	271	244	7.7	271	2987	622.0	564.3
	7	24	0	31	0	0	55	10.6	224	31.5	55	257	10.5	55	606	150.0	136.1
	8	25	0	15	1	0	41	7.9	258	28.8	41	267	8.8	41	452	128.7	116.8
	9	14	0	8	0	0	22	4.2	265	33.2	22	269	11.3	22	242	70.9	64.4
	10	22	0	31	0	0	53	10.2	288	32.7	53	272	10.1	53	584	185.5	168.3
	11	17	0	13	0	0	30	5.8	306	39.7	30	276	11.2	30	331	111.6	101.3
	12	1	0	2	0	0	3	0.6	309	53.4	3	289	8.5	3	33	11.3	10.2
	13	0	0	4	0	0	4	0.8	327	44.2	4	285	2.4	4	44	15.9	14.4
	14	2	0	2	0	0	4	0.8	310	34.8	4	284	9.3	4	44	15.1	13.7
	15	0	0	2	0	0	2	0.4	312	39.6	2	284	5.7	2	22	7.6	6.9
	16	1	0	0	0	0	1	0.2	307	0.0	1	283	0.0	1	11	3.7	3.4
Sample Total		283	3	231	2	0	519	100.0	220	53.0	519	254	16.2	519	5,720	1,388.1	1,259.3
Sex Composition (%)		54.5	0.6	44.5	0.4												
Not Aged		27	1	26	0	0	54	10.4	230	53.9	54	257	16.7	54			
Sex Composition (%)		50.0	1.9	48.1	0.0												

Table 10. Age, sex, and size composition of Pacific herring samples obtained after the fishery in Chenik Head and Amakdedori Creek areas, Kamishak Bay District, 30 April 1994.

Sample Period	Age	Numbers of Fish						Percent of Total	Weight			Length		
		Immature Male	Immature Female	Ripe Female	Spawned Female	Unknown	Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
30 April	1													
	2													
	3	1	0	0	0	0	1	0.3	54	0.0	1	191	0.0	1
	4	3	0	0	4	0	7	2.3	112	13.2	7	238	13.6	7
	5	9	0	0	8	0	17	5.5	137	14.6	17	251	10.8	17
	6	86	1	3	102	0	192	62.1	152	16.6	192	261	9.9	192
	7	14	0	1	21	0	36	11.7	182	25.1	36	276	11.1	36
	8	5	0	0	5	0	10	3.2	196	36.6	10	278	14.6	10
	9	7	0	0	7	0	14	4.5	202	32.9	14	282	16.9	14
	10	9	0	0	11	0	20	6.5	221	28.3	20	292	10.6	20
	11	5	0	1	4	0	10	3.2	249	35.1	10	303	10.2	10
	12	1	0	0	0	0	1	0.3	140	0.0	1	261	0.0	1
	13	0	0	0	1	0	1	0.3	300	0.0	1	317	0.0	1
	14													
	15													
	16													
Sample Total		140	1	5	163	0	309	100.0	165	35.9	309	267	17.3	309
Sex Composition (%)		45.3	0.3	1.6	52.8									
Not Aged		19	0	1	10	1	31	10.0	179	119.0	31	265	12.6	31
Sex Composition (%)		61.3	0.0	3.2	32.3									

Table 11. Age, sex, and size composition of herring samples obtained after the fishery from Iniskin Bay, Kamishak Bay District, 1 May 1994.

Sample Period	Age	Numbers of Fish						Percent of Total	Weight		Number Weighed	Length		Number Measured
		Immature Male	Ripe Female	Female	Spawmed Female	Unknown	Total		Mean (g)	SD		Mean (mm)	SD	
1 May	1													
	2													
	3													
	4	8	2	4	4	0	18	7.9	126	15.1	18	235	8.4	18
	5	5	0	2	0	0	7	3.1	148	12.9	7	252	6.0	7
	6	17	3	11	15	0	46	20.3	178	33.4	46	262	12.1	46
	7	10	1	5	7	0	23	10.1	194	32.8	23	274	14.6	23
	8	2	0	4	8	0	14	6.2	241	36.1	14	287	7.4	14
	9	7	2	4	13	1	27	11.9	256	113.9	27	289	8.8	27
	10	25	2	8	15	0	50	22.0	245	37.0	50	293	12.2	50
	11	16	3	7	7	0	33	14.5	262	38.7	33	295	10.5	33
	12	0	0	3	2	0	5	2.2	294	39.4	5	299	12.9	5
	13	1	0	0	2	0	3	1.3	257	9.5	3	295	11.1	3
	14	0	0	0	1	0	1	0.4	277	0.0	1	308	0.0	1
	15													
	16													
Sample Total		91	13	48	74	1	227	100.0	219	67.0	227	279	21.5	227
Sex Composition (%)		40.1	5.7	21.1	32.6									
Not Aged		9	0	4	5	0	18	7.9	236	68.7	18	283	17.2	18
Sex Composition (%)		50.0	0.0	22.2	27.8									

Table 12. Age, sex, and size composition of combined commercial sac roe herring harvest by purse seine in Chenik Head and Amakdedori Creek areas, Kamishak Bay District, 25 and 29 April 1994.

	Numbers of Fish							Percent of Total	Weight			Standard Length			Biomass		
	Age	Immature		Ripe	Spawned	Unknown	Total		Mean	SE	Number	Mean	SE	Number	No. Fish	Tons	Tonnes
		Male	Female	Female	Female				(g)		Weighed	(mm)		Measured	X 1000		
Combined Harvest	1	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0	0	0.0	0.0
	2	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0	0	0.0	0.0
	3	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0	0	0.0	0.0
	4	12	0	6	0	0	18	2.1	147	3.4	18	227	1.5	18	187	30.4	27.5
	5	16	1	17	0	0	34	3.8	174	4.0	34	240	1.4	34	343	65.9	59.8
	6	271	2	179	1	0	453	51.5	190	1.1	453	244	0.4	453	4,589	961.9	872.6
	7	45	0	49	0	0	94	10.6	223	3.4	94	255	1.1	94	949	233.9	212.2
	8	39	0	24	1	0	64	7.3	256	4.0	64	264	1.2	64	654	184.7	167.6
	9	31	0	19	0	0	50	5.5	261	5.1	50	266	1.7	50	488	140.7	127.7
	10	42	0	55	0	0	97	10.9	283	3.4	97	270	1.0	97	971	303.5	275.3
	11	27	0	23	0	0	50	5.7	300	5.6	50	275	1.6	50	507	167.8	152.3
	12	3	0	5	0	0	8	0.9	315	13.5	8	284	2.8	8	77	26.8	24.3
	13	0	0	5	0	0	5	0.6	325	18.3	5	283	1.0	5	53	19.0	17.2
	14	3	0	2	0	0	5	0.6	309	14.4	5	283	3.9	5	53	18.0	16.4
	15	0	0	2	0	0	2	0.2	312	28.0	2	284	4.0	2	22	7.6	6.9
	16	2	0	0	0	0	2	0.2	297	0.0	2	277	0.0	2	20	6.5	5.9
		491	3	386	2	0	882	100.0	220	1.8	882	253	0.5	882	8,913	2,166.6	1,965.6

Table 13. Age, sex, and size composition of early spawning migration herring escapement based on samples obtained before and after the fishery from Chenik Head, Nordyke Island, Amakdedori Creek, and Iniskin Bay areas, Kamishak Bay District, 22 April-1 May 1994.

	Numbers of Fish							Percent of Total	Weight			Standard Length			Biomass		
	Age	Immature		Ripe	Spawned Female	Unknown	Total		Mean (g)	SE	Number Weighed	Mean (mm)	SE	Number Measured	No. Fish X 1000	Tons	Tonnes
		Male	Female	Female													
Spawning Migration	1																
	2	0	0	0	0	3	3	0.2	18	2.3	3	131	9.5	3	225	4.4	4.0
	3	2	0	0	0	0	2	0.1	55	0.7	2	184	10.6	2	150	9.0	8.2
	4	22	5	9	8	0	44	3.3	129	22.2	44	232	11.8	44	3,301	469.0	425.5
	5	32	3	11	8	0	54	4.0	153	20.2	54	244	10.9	54	4,051	682.4	619.1
	6	302	13	174	119	0	608	45.3	176	28.7	608	252	12.1	608	45,612	8,849.7	8,028.4
	7	74	3	45	28	0	150	11.2	208	34.8	150	264	14.4	150	11,253	2,577.7	2,338.5
	8	33	1	25	13	0	72	5.4	246	39.4	72	272	12.9	72	5,401	1,465.2	1,329.3
	9	45	3	28	20	1	97	7.2	253	69.7	97	277	13.6	97	7,277	2,029.2	1,840.9
	10	88	3	56	26	0	173	12.9	266	42.1	173	281	14.1	173	12,978	3,799.6	3,447.0
	11	49	4	36	11	0	100	7.5	285	42.9	100	286	13.6	100	7,502	2,356.3	2,137.7
	12	6	0	6	2	0	14	1.0	289	57.8	14	287	16.0	14	1,050	334.4	303.4
	13	8	0	5	3	0	16	1.2	289	40.4	16	285	16.4	16	1,200	382.8	347.3
	14	1	0	2	1	0	4	0.3	310	32.3	4	290	13.5	4	300	102.5	93.0
	15	3	0	0	0	0	3	0.2	357	40.6	3	291	8.7	3	225	88.6	80.3
	16	1	0	0	0	0	1	0.1	320	0.0	1	282	0.0	1	75	26.5	24.0
Combined Total		666	35	397	239	4	1,341	100.0	209	60.2	1341	262	20.9	1,341	100,600	23,177.4	21,026.4
Sex Composition (%)		49.7	2.6	29.6	17.8												
Not Aged		67	3	34	15	1	120	8.9	210	78.0	120	261	18.6	120			
Sex Composition (%)		55.8	2.5	28.3	12.5												

Table 14. Preliminary age, sex, and size composition of herring run, Kamishak Bay District, 22 April to 1 May 1994. These data may not accurately characterize the total run since no samples were collected during May and June. Data in this table may be modified for future reports, if results of 1995 sampling indicate age-3 and -4 herring are more abundant.

	Numbers of Fish							Percent		Weight		Standard Length			Biomass		
	Age	Immature		Ripe	Spawned	Unknown	Total	Total	Mean (g)	SE	Number Weighed	Mean (mm)	SE	Number Measured	No. Fish X 1000	Tons	Tonnes
		Male	Female	Female													
Total Run	1	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0	0	0.0	0.0
	2	0	0	0	0	3	3	0.2	18	1.3	3	131	5.5	3	225	4.4	4.0
	3	2	0	0	0	0	2	0.1	55	0.5	2	184	7.5	2	150	9.0	8.2
	4	34	5	15	8	0	62	3.2	130	3.2	62	232	1.7	62	3,488	499.4	453.0
	5	48	3	29	8	0	88	4.0	155	2.5	88	244	1.4	88	4,394	748.3	678.9
	6	573	13	356	119	0	1,061	45.8	177	1.1	1,061	251	0.4	1,061	50,201	9,811.6	8,901.0
	7	119	3	94	28	0	244	11.1	209	2.6	244	263	1.1	244	12,202	2,811.6	2,550.7
	8	72	1	50	13	0	136	5.5	247	4.1	136	271	1.4	136	6,055	1,649.9	1,496.9
	9	76	3	47	20	1	147	7.1	254	6.6	147	276	1.3	147	7,765	2,169.9	1,968.6
	10	130	3	111	26	0	270	12.7	267	3.0	270	280	1.0	270	13,949	4,103.1	3,722.3
	11	76	4	59	11	0	150	7.3	286	4.0	150	285	1.3	150	8,009	2,524.1	2,290.0
	12	9	0	11	2	0	22	1.0	291	14.4	22	287	4.0	22	1,127	361.2	327.7
	13	8	0	10	3	0	21	1.1	291	9.7	21	285	3.9	21	1,253	401.8	364.5
	14	4	0	4	1	0	9	0.3	310	13.8	9	289	5.7	9	353	120.5	109.4
	15	3	0	2	0	0	5	0.2	353	21.4	5	290	4.6	5	247	96.2	87.2
	16	3	0	0	0	0	3	0.1	315	0.0	3	281	0.0	3	95	33.0	29.9
		1,157	35	788	239	4	2,223	100.0	210	1.5	2,223	261	0.5	2,223	109,513	25,344.0	22,992.0

Table 15. Herring biomass estimates by area and date, Southern District, Lower Cook Inlet, 1994. DNS indicated that an area within the District was not surveyed during a flight.

Date	Survey Conditions	Spawn Sightings		Anchor, Bluff Points	West Spit	East Spit, Mud Bay, & North Shore	Bear Cove	Mallard Bay	Glacier Spit	Peterson China Poot	Bay Tutka Bay	Daily Total
		Number	Length (Miles)									
<u>Biomass Estimates in Tonnes</u>												
3 May	2	0	0.00	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.4
10 May	3	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	0.0
16 May	1	0	0.00	DNS	0.0	72.5	0.0	6.9	1.4	0.0	0.0	80.7
25 May	2	0	0.00	5.5	0.0	11.1	0.0	0.0	0.0	0.0	0.0	16.6
1 June	2	0	0.00	0.0	0.0	6.9	6.9	65.6	193.8	6.9	89.1	369.1
6 June	2	0	0.00	0.0	0.0	0.0	295.8	60.0	56.5	1.4	11.1	424.7
<u>Biomass Estimates in Tons</u>												
3 May	2	0	0.00	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	1.5
10 May	3	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DNS	0.0
16 May	1	0	0.00	DNS	0.0	79.9	0.0	7.6	1.5	0.0	0.0	89.0
25 May	2	0	0.00	6.1	0.0	12.2	0.0	0.0	0.0	0.0	0.0	18.3
1 June	2	0	0.00	0.0	0.0	7.6	7.6	72.3	213.6	7.6	98.2	406.9
6 June	2	0	0.00	0.0	0.0	0.0	326.1	66.1	62.3	1.5	12.2	468.2



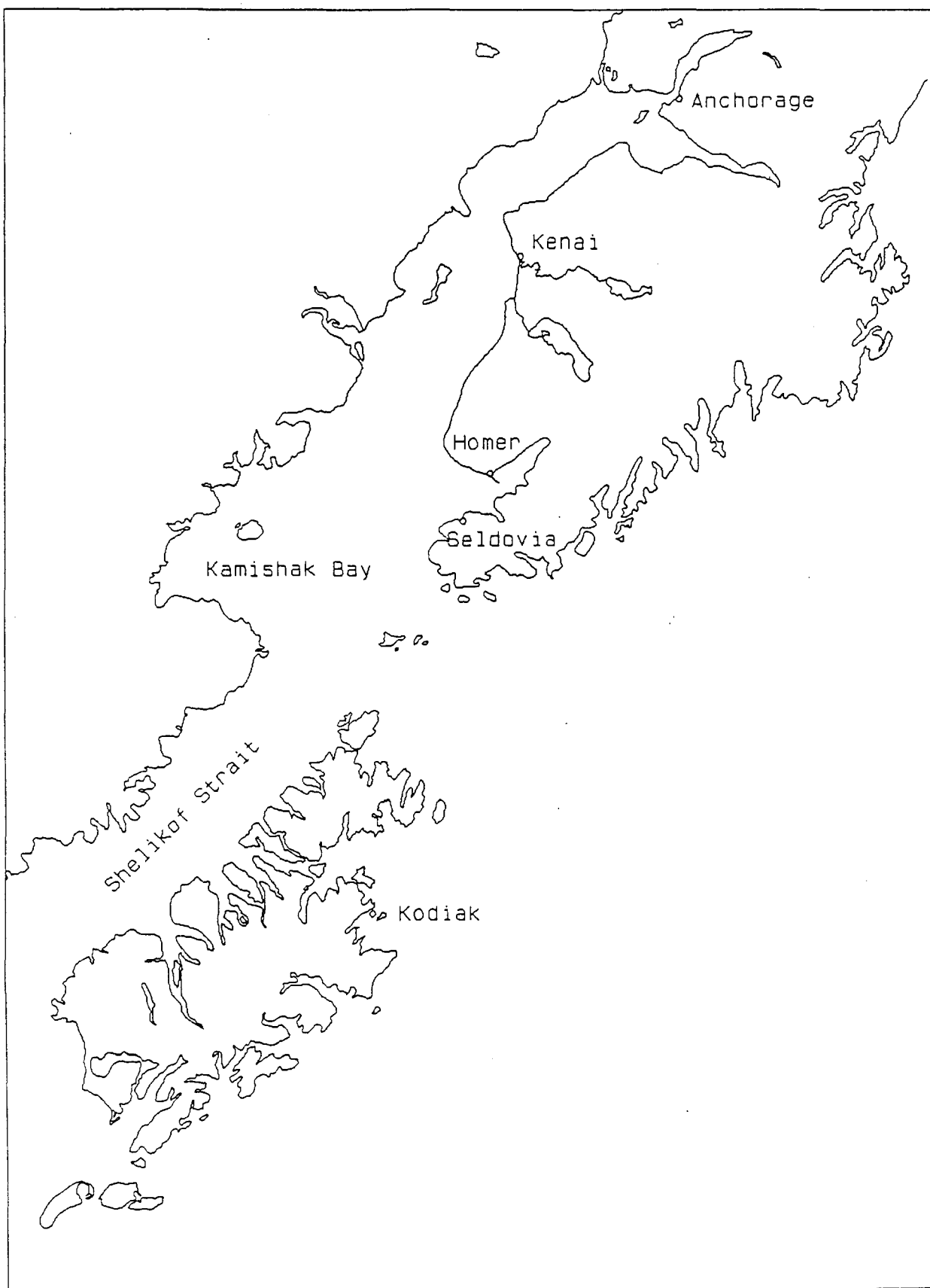


Figure 1. Kamishak Bay and Shelikof Strait.

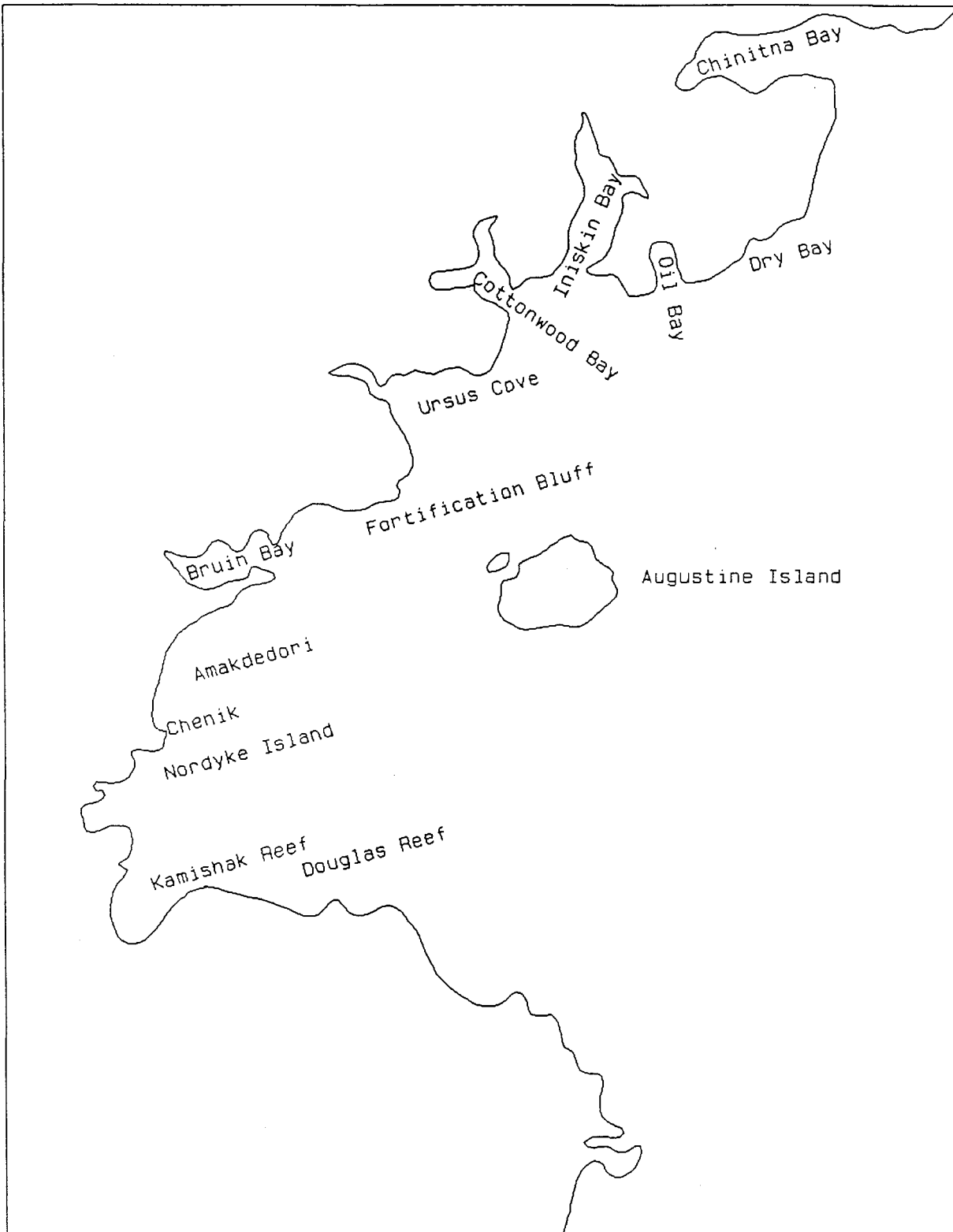


Figure 2. Kamishak Bay District aerial survey landmarks, Lower Cook Inlet.

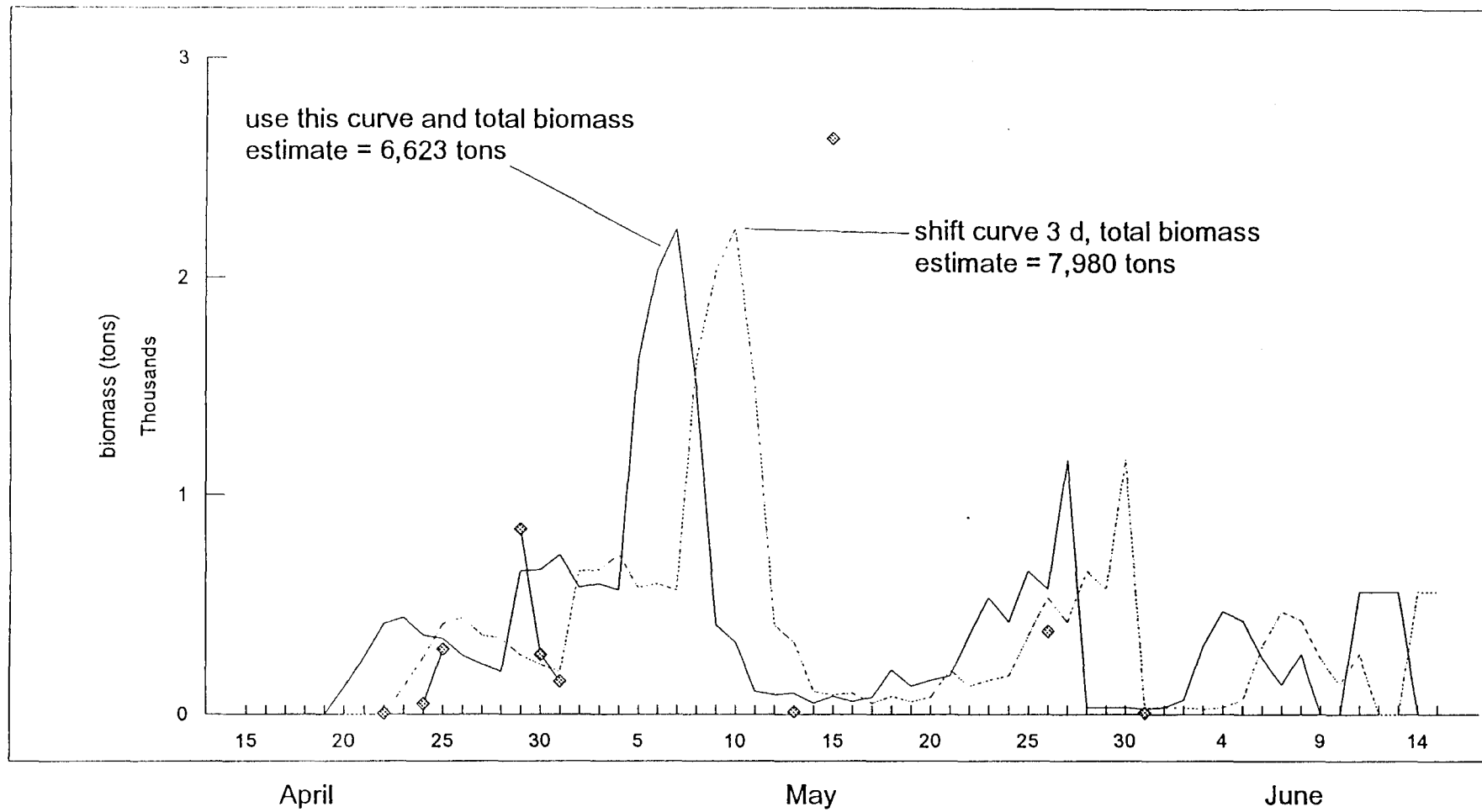


Figure 3. Observed and expected 1994 Kamishak Bay District herring biomass by date.

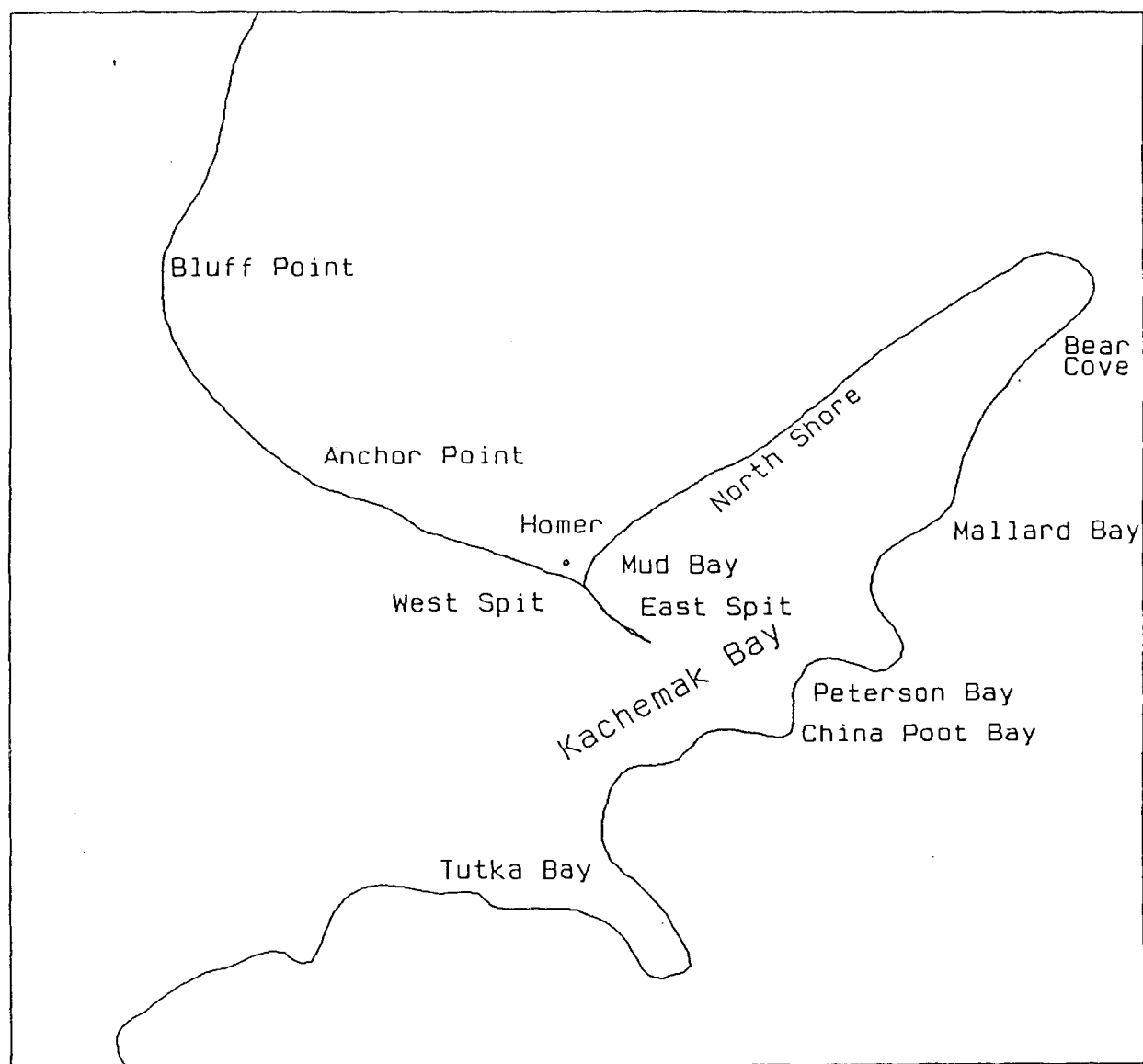


Figure 4. Southern District aerial survey landmarks, Lower Cook Inlet

Appendix A. Commercial herring harvest abundance (x 1,000) by harvest year, Kamishak Bay District.

Harvest Year	Age																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
78	0	55	400	1,353	915	93	88	131	110	110	44	11	0	0	0	0	3,310
79	0	0	618	533	1,012	725	53	32	43	21	21	21	0	0	0	0	3,079
no harvest	80-84																
85	0	0	10	569	700	1,124	739	1,177	433	253	204	49	0	0	0	0	5,258
86	0	0	1,093	227	1,028	889	1,586	1,190	1,609	647	250	196	58	8	0	0	8,781
87	0	0	2,342	3,098	476	5,133	3,612	3,696	2,454	3,182	1335	579	476	112	9	0	26,504
88	90	6	120	5,593	5,338	592	5,160	2,687	2,743	1,231	1485	481	92	103	14	0	25,735
89	0	0	12	388	7,599	4,704	825	2,796	1,615	1,168	938	662	234	51	57	37	21,086
90	0	0	154	364	603	4,327	2,333	647	789	444	211	94	34	26	2	15	10,043
91	0	0	1,102	697	787	945	3,690	1,462	45	270	112	22	22	0	0	0	9,154
92	0	0	87	8,344	1,848	520	491	1,415	491	115	173	29	29	58	0	0	13,600
93	0	0	26	367	10,077	2,362	945	945	1,916	630	105	52	26	26	0	0	17,477
94	0	0	0	187	343	4,589	949	654	488	971	507	77	53	53	22	20	8,913

Appendix B. Herring run abundance (x 1,000) by year class, Kamishak Bay District.

Year Class	Age															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	133	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	131	169	0	0	0	0
68	0	0	0	0	0	0	0	0	0	328	170	0	0	0	0	0
69	0	0	0	0	0	0	0	0	328	170	0	0	0	0	0	0
70	0	0	0	0	0	0	0	394	342	0	0	0	0	0	0	0
71	0	0	0	0	0	0	262	255	0	0	0	0	0	0	0	0
72	0	0	0	0	0	278	423	0	0	0	109	0	0	103	37	0
73	0	0	0	0	2,734	5,782	0	0	0	217	0	574	767	445	66	194
74	0	0	0	4,052	8,060	0	0	0	1,411	0	2,408	2,606	2,026	475	299	43
75	0	0	1,199	4,241	0	1,601	0	1,194	0	2,980	3,321	2,294	420	272	157	0
76	0	167	4,934	0	8,007	0	2,279	0	5,097	8,586	5,498	2,202	1,219	294	0	0
77	0	0	0	36,834	0	6,946	0	13,843	21,361	13,805	6,810	3,414	490	177	0	0
78	0	0	3,203	0	5,318	0	8,696	15,791	10,645	5,644	4,878	856	360	774	0	69
79	0	0	0	11,178	0	13,252	21,054	17,647	12,567	6,121	2,050	528	388	237	195	0
80	0	0	1,845	0	8,237	11,805	18,774	12,423	8,586	4,188	1,035	390	238	317	0	0
81	0	0	0	6,693	13,645	25,570	24,120	14,965	6,445	1,939	2,328	475	1,149	0	0	0
82	0	0	111	3,015	3,622	2,809	4,947	4,400	1,767	1,551	954	963	0	0	0	0
83	0	0	14,513	48,226	27,515	27,215	22,438	6,477	6,606	5,719	7,557	0	0	0	0	0
84	0	0	41,071	49,857	47,063	29,131	14,029	19,016	17,402	14,455	0	0	0	0	0	0
85	0	0	9,071	5,756	7,897	8,864	6,600	8,599	7,762	0	0	0	0	0	0	0
86	0	205	1,544	10,739	11,485	6,969	8,589	6,116	0	0	0	0	0	0	0	0
87	90	0	5,225	16,199	24,878	21,464	12,170	0	0	0	0	0	0	0	0	0
88	0	10	34,981	111,689	91,692	50,539	0	0	0	0	0	0	0	0	0	0
89	29	0	1,167	3,342	4,190	0	0	0	0	0	0	0	0	0	0	0
90	0	0	237	3,079	0	0	0	0	0	0	0	0	0	0	0	0
91	0	0	121	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix C. Herring escapement abundance (x 1,000) by year class, Kamishak Bay District.

Year Class	Age															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	87	148	0	0	0	0
68	0	0	0	0	0	0	0	0	0	218	149	0	0	0	0	0
69	0	0	0	0	0	0	0	0	218	149	0	0	0	0	0	0
70	0	0	0	0	0	0	0	263	299	0	0	0	0	0	0	0
71	0	0	0	0	0	0	174	223	0	0	0	0	0	0	0	0
72	0	0	0	0	0	185	370	0	0	0	109	0	0	95	28	0
73	0	0	0	0	1,819	5,057	0	0	0	217	0	525	709	333	52	0
74	0	0	0	2,699	7,048	0	0	0	1,411	0	2,204	2,410	1,550	372	242	0
75	0	0	799	3,708	0	1,601	0	1,194	0	2,727	3,071	1,715	328	221	155	0
76	0	112	4,316	0	8,007	0	2,279	0	4,664	7,939	4,163	1,721	985	268	0	0
77	0	0	0	36,834	0	6,946	0	12,666	19,752	10,623	5,325	2,752	456	177	0	0
78	0	0	3,203	0	5,318	0	7,957	14,601	8,191	4,413	3,940	762	338	716	0	0
79	0	0	0	11,178	0	12,128	19,468	13,951	9,824	4,953	1,839	506	359	211	173	0
80	0	0	1,845	0	7,537	10,916	15,162	9,736	6,971	3,744	923	361	212	264	0	0
81	0	0	0	6,124	12,617	20,437	18,960	12,169	5,656	1,669	2,155	423	1,096	0	0	0
82	0	0	101	2,788	3,146	2,217	4,122	3,753	1,722	1,436	849	886	0	0	0	0
83	0	0	13,420	45,128	22,177	22,511	20,105	5,015	6,115	5,089	7,050	0	0	0	0	0
84	0	0	38,729	44,264	39,464	24,804	10,339	17,601	15,486	13,484	0	0	0	0	0	0
85	0	0	8,951	5,368	7,294	7,919	6,109	7,654	7,274	0	0	0	0	0	0	0
86	0	199	1,532	10,375	10,698	6,449	7,644	5,462	0	0	0	0	0	0	0	0
87	0	0	5,071	15,502	23,030	19,102	11,221	0	0	0	0	0	0	0	0	0
88	0	10	33,879	103,345	81,615	45,950	0	0	0	0	0	0	0	0	0	0
89	29	0	1,080	2,975	3,847	0	0	0	0	0	0	0	0	0	0	0
90	0	0	211	2,892	0	0	0	0	0	0	0	0	0	0	0	0
91	0	0	121	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D. Commercial herring harvest age composition (%) by year of harvest, Kamishak Bay District.

Harvest Year	Age															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
78	0.0	1.7	12.1	41.0	27.6	2.8	2.6	4.0	3.3	3.3	1.3	0.3	0.0	0.0	0.0	0.0
79	0.0	0.0	20.1	17.3	32.9	23.5	1.7	1.0	1.4	0.7	0.7	0.7	0.0	0.0	0.0	0.0
no data 80																
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
no data 82																
83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
no data 84																
85	0.0	0.0	0.2	10.8	13.3	21.4	14.1	22.4	8.2	4.8	3.9	0.9	0.0	0.0	0.0	0.0
86	0.0	0.0	12.4	2.6	11.7	10.2	18.1	13.6	18.4	7.4	2.8	2.2	0.7	0.1	0.0	0.0
87	0.0	0.0	8.8	11.7	1.8	19.4	13.6	13.9	9.3	12.0	5.0	2.2	1.8	0.4	0.0	0.0
88	0.1	0.0	0.5	21.8	20.8	2.3	20.1	10.5	10.7	4.8	5.8	1.9	0.4	0.4	0.1	0.0
89	0.0	0.0	0.1	1.8	36.0	22.3	3.9	13.3	7.7	5.5	4.4	3.1	1.1	0.2	0.3	0.2
90	0.0	0.0	1.5	3.6	6.0	43.1	23.2	6.4	7.9	4.4	2.1	0.9	0.3	0.3	0.0	0.1
91	0.0	0.0	12.0	7.6	8.6	10.3	40.3	16.0	0.5	2.9	1.2	0.2	0.2	0.0	0.0	0.0
92	0.0	0.0	0.6	61.4	13.6	3.8	3.6	10.4	3.6	0.8	1.3	0.2	0.2	0.4	0.0	0.0
93	0.0	0.0	0.2	2.1	57.7	13.5	5.4	5.4	11.0	3.6	0.6	0.3	0.2	0.2	0.0	0.0
94	0.0	0.0	0.0	2.1	3.8	51.5	10.6	7.3	5.5	10.9	5.7	0.9	0.6	0.6	0.2	0.2



Appendix E. Herring run age composition (%) by year of harvest, Kamishak Bay District.

Harvest Year	Age															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
78	0.0	1.7	12.1	40.9	27.6	2.8	2.6	4.0	3.3	3.3	1.3	0.3	0.0	0.0	0.0	0.0
79	0.0	0.0	20.1	17.3	32.8	23.6	1.7	1.0	1.4	0.7	0.7	0.7	0.0	0.0	0.0	0.0
no data 80																
81	0.0	0.0	6.5	74.2	16.1	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
no data 82																
83	0.0	0.0	6.0	36.7	17.4	22.8	7.5	3.9	4.6	0.7	0.4	0.0	0.0	0.0	0.0	0.0
no data 84																
85	0.0	0.0	0.2	10.8	13.3	21.4	14.1	22.4	8.2	4.8	3.9	0.9	0.0	0.0	0.0	0.0
86	0.0	0.0	12.5	2.6	11.7	10.1	18.1	13.5	18.3	7.4	2.8	2.2	0.7	0.1	0.0	0.0
87	0.0	0.0	21.7	25.4	1.9	13.5	9.9	9.3	5.6	7.3	2.9	1.2	1.1	0.2	0.0	0.0
88	0.1	0.1	5.9	32.3	17.8	1.8	15.6	8.1	8.1	3.7	4.4	1.4	0.3	0.3	0.0	0.0
89	0.0	0.0	1.2	4.6	37.2	21.5	3.9	11.8	6.8	4.8	3.9	2.7	1.0	0.2	0.2	0.2
90	0.0	0.0	5.5	11.4	8.4	30.9	23.8	4.7	6.8	4.4	2.2	0.9	0.5	0.3	0.2	0.0
91	0.0	0.0	35.8	16.6	11.7	9.1	14.3	6.6	1.8	2.0	1.1	0.5	0.4	0.2	0.0	0.0
92	0.0	0.0	0.6	61.2	13.6	3.8	3.6	10.4	3.6	0.9	1.3	0.2	0.2	0.4	0.0	0.0
93	0.0	0.0	0.1	2.1	57.7	13.5	5.4	5.4	10.9	3.6	0.6	0.3	0.1	0.1	0.0	0.0
94	0.0	0.1	0.1	2.8	3.8	46.4	11.2	5.6	7.1	13.3	6.9	0.9	1.1	0.3	0.2	0.1

Appendix F. Herring mean weight (g) by harvest year and age, Kamishak Bay District.

Harvest Year	Age															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
78	0	16	61	85	121	168	170	188	204	217	212	247	0	0	0	0
79	0	0	68	98	128	156	170	197	210	221	272	265	0	0	0	0
no data 80-84																
85	0	0	64	125	155	182	205	220	238	248	255	275	0	0	0	0
86	0	0	88	104	155	189	215	233	249	261	272	281	292	295	0	0
87	0	0	91	134	162	198	218	241	251	267	276	275	288	288	287	0
88	3	18	84	123	163	196	218	236	248	261	266	280	298	262	282	0
89	0	0	98	131	158	199	228	245	254	268	285	288	298	293	313	296
90	0	0	90	135	162	182	220	245	256	273	289	303	310	333	269	299
91	0	0	79	118	172	208	214	259	267	288	280	229	413	0	0	0
92	0	0	99	116	156	210	229	234	266	304	303	279	333	349	0	0
93	0	0	88	131	152	193	230	245	260	293	302	317	382	318	0	0
94	0	0	0	147	174	190	223	256	261	283	300	315	325	309	312	297

Appendix G. Herring mean length (mm) by harvest year and age, Kamishak Bay District.

Harvest Year	Age															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
78	0	120	172	191	212	235	235	243	247	252	248	252	0	0	0	0
79	0	0	186	208	224	237	246	255	258	254	274	268	0	0	0	0
no data 80-84																
85	0	0	173	208	220	230	237	242	248	252	255	253	0	0	0	0
86	0	0	185	197	220	233	241	247	250	254	256	259	259	262	0	0
87	0	0	185	209	221	233	238	245	247	251	254	255	259	256	256	0
88	70	117	182	208	228	239	246	251	254	257	258	262	263	263	266	0
89	0	0	191	214	225	242	251	256	259	260	266	266	265	267	263	265
90	0	0	185	212	227	232	248	258	261	263	268	275	274	283	257	267
91	0	0	182	205	229	240	240	253	271	260	260	247	285	0	0	0
92	0	0	200	208	228	249	252	253	263	272	272	273	267	280	0	0
93	0	0	198	226	237	253	266	270	273	282	285	292	296	293	0	0
94	0	0	0	227	240	244	255	264	266	270	275	284	283	283	284	277

Appendix H. Surface water temperatures in Iniskin Bay and herring biomass observed in Kamishak Bay District, between 18 April and 1 May, 1989, 1991-1994.

		1989		1991		1992		1993		1994	
		Temp. (°C)	Biomass (tonnes)	Temp. (°C)	Biomass (tonnes)	Temp. (°C)	Biomass (tonnes)	Temp. (°C)	Biomass (tonnes)	Temp. (°C)	Biomass (tonnes)
April	18			2.0				4.5	a	0.0	
	19	2.5	a	2.0				4.5		1.0	
	20	2.8	b	2.0	a	3.5		4.0	a	2.0	
	21			2.0	a	3.5	a	4.5		2.0	a
	22			2.0		3.5	85			3.0	5
	23	4.3	a	2.0	c	4.0	569		1,465		
	24	3.4		3.0	808	4.0	1,452			3.0	50
	25	3.4	b	3.5			2,628		497	3.0	300
	26	3.3	b	3.5	a					2.5	
	27	3.6	850		a		590		368	3.0	
	28				a		1,846			3.0	
	29	4.3	a				2,930			3.5	843
	30	4.1	8,720				7,179			3.5	276
May	1				a		3,701			3.0	153

a = Survey flown, no herring seen, no AWL sample obtained.  
b = No survey flown, AWL sample obtained.  
c = Survey flown, no herring seen, AWL sample obtained.

Appendix I. Preseason forecast of abundance and age composition of the 1994 Kamishak Bay District herring run. Information obtained from Yuen et al. (1994).

Age	Abundance(x 1,000)	Percent of Total
3	13,768	11.3
4	843	0.7
5	5,570	4.6
6	83,431	68.7
7	7,413	6.1
8	2,160	1.8
9	1,047	0.9
10	3,867	3.2
11+	3,390	2.8

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